

REMARKS

This application has been carefully reviewed in light of the Office Action dated October 15, 2003 (Paper No. 17). Claims 1 to 26 are currently in the application, of which Claims 1 to 4, 8 to 11, 17, 21, 24 and 25 are the independent claims. Reconsideration and further examination are respectfully requested.

Claims 1 to 3, 8 to 10, 17, 18, 21 and 22 were rejected under 35 U.S.C. § 103(b) over U.S. Patent No. 5,384,587 (Takagi); Claims 4 to 6, 11, 13, 14, 20 and 24 to 26 were rejected under § 103(a) over Takagi in view of U.S. Patent No. 5,359,355 (Nagoshi); Claim 7 was rejected under § 103(a) over Takagi in view of Nagoshi and further in view of EP 0 516 420 (Arai); Claims 8 to 10 also were rejected under § 103(a) over Takagi in view of Arai; Claim 12 was rejected under § 103(a) over Takagi in view of Nagoshi and further in view of U.S. Patent No. 5,488,398 (Matsubara); and Claims 15 and 16 were rejected under § 103(a) over Takagi in view of Nagoshi and further in view of U.S. Patent No. 5,070,345 (Lahut); and Claims 19 and 23 were rejected under § 103(a) over Takagi. Applicants have considered the Examiner's comments together with the applied references and respectfully submit that the claims and patentably distinguishable over the applied references for at least the following reasons.

Independent Claims 1 to 3 concern recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material. Information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on the recording material is obtained. Based on this

information, the total amount of ink to be ejected to the unit areas, which exist astride the boundary between adjacent ones of the bands, is reduced. As indicated above, Claims 1 to 3 have been amended to clarify that it is the “total” amount of ink to be ejected to the unit areas that is reduced.

The applied references are not seen to disclose the foregoing features of the present invention. In particular, the applied references are not seen to disclose at least the feature of reducing the total amount of ink to be ejected for unit areas that exist astride a boundary between adjacent bands of scanning recording.

As described in Applicants’ previous response, Takagi concerns ink-jet recording in which scanned image areas are partially overlapped, with the overlapped portions being printed in two scans. In order to reduce the appearance of banding in the overlapped portions, Takagi describes a method for controlling the number of ink droplets ejected in each scan. Applicants respectfully submit, however, that the total amount of ink droplets ejected in the overlapped portions is not reduced.

Column 8, lines 1 to 9, of Takagi, describe a method for dividing the number of ink droplets intended for a given pixel in an overlap portion between orifices of the recording head used to form the pixels in different scannings. Specifically, the number of ink droplets intended for one of these pixels is multiplied by a first ratio (2/8, 4/8, 6/8, etc.) to provide the number of droplets to be ejected for the particular pixel during a first scan. The number of intended ink droplets is then multiplied by a second ratio (6/8, 4/8, 2/8, etc.) to provide the number of droplets to be ejected for the particular pixel during a second scan. Figure 4 of Takagi depicts one example of how these ratios are used to divide

the number of ink droplets ejected for the pixels in the overlapped portions between the two scans, while maintaining the total number of ink droplets ejected for a particular pixel within an overlapped portion.

While Takagi indicates that the number of droplets for individual pixels may vary depending on the image data (column 8, lines 20 and 21), this is not seen to affect the use of the system depicted in Figure 4 for dividing the number of droplets between scans. Column 8, lines 21 to 24, describes that whatever the number of ink droplets required for a particular pixel (N'), that number is multiplied using ratios such as those depicted in Figure 4 to determine the number of droplets ejected during each scan. However, based on Figure 4, Applicants submit that it is clear that the total number of droplets ejected for a particular pixel in the overlapped region is maintained at the required number (N') using the overlapping scans and is not reduced.

The Office Action contended that density distribution depicted in Figure 9 of Takagi indicates that the amount of ink ejected for a particular pixel is reduced for the overlapped portions. Applicants respectfully disagree with this interpretation of Figure 9. As described in column 9, lines 6 to 49, when the total number of droplets used for a particular pixel is divided between two scans, the final size of the pixel is smaller than if the total number of droplets for the pixel is ejected in a single scan. This difference in size of pixel, and therefore image density, is not seen to be the result of changing the amount of ink droplets used for a particular pixel. Rather, this difference in size is seen to be the result of a first group of droplets being fixed in the recording medium in the time between two scans thereby reducing the spread of the ink when the second group of droplets is

ejected. Therefore, Figure 9 is not seen to depict a change in the amount of ink ejected for pixels in the overlapped portions, but rather is seen to depict the effect of a period of time passing between the ejection of two groups of droplets for a particular pixel when the amount of ink for the pixel is divided between the two groups.

In view of the foregoing, Takagi is not seen to disclose at least the feature of reducing the total amount of ink to be ejected for unit areas that exist astride a boundary between adjacent bands of scanning recording.

Nagoshi, Arai, Matsubara and Lahut, which were applied in the rejections of certain other claims, are not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Specifically, Nagoshi, Arai, Matsubara and Lahut are not seen to disclose or suggest at least the feature of reducing the total amount of ink to be ejected for unit areas that exist astride a boundary between adjacent bands of scanning recording.

Accordingly, independent Claims 1 to 3 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 102(b) rejection of Claims 1 to 3 are respectfully requested.

Independent Claims 8 to 10 concern effecting recording on a recording material with relative scanning movement between a recording head and the recording material. Information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material is obtained. An amount of ink ejected to an area to be thinned in the unit areas is reduced on the basis of the obtained information, where the sizes of the unit area and the area to be thinned are different from each other.

The applied references are not seen to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not seen to disclose or suggest at least the features of dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on a recording material into a plurality of unit areas and reducing the amount of ink ejected to an area to be thinned in the unit areas based on obtained information indicating an amount of ink to be ejected to each of the plurality of unit areas, where the sizes of the unit area and the area to be thinned are different from each other.

The Office Action contended that Figure 4 of Takagi depicts both a unit area (the area covered by orifice no. 4 to orifice no. 125 in the second main scanning) and a thinning area (the area covered by orifice no. 125 to orifice no. 128 in the first main scanning, and the area covered by orifice no. 1 to orifice no. 4 in the second main scanning). Applicants respectfully disagree with this comparison with the present invention.

Applicants submit that the thinning areas of the claimed invention are actually in the provided unit areas. However, as indicated on the modified Figure 4 of Takagi in the Office Action, the alleged thinning area in Takagi is adjacent to and not included in the alleged unit area. Furthermore, Takagi is not seen to disclose or suggest anything to indicate that the amount of ink ejected in the alleged thinning area is reduced based on information indicating an amount of ink to be ejected in the alleged unit area. Any reduction in the amount of ink ejected in a particular scan in Takagi is seen to be purely a function of the ratios depicted in Figure 4 and the amount of ink to be ejected for

each particular pixel. Therefore, Takagi is not seen to disclose or suggest at least the features of dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on a recording material into a plurality of unit areas and reducing the amount of ink ejected to an area to be thinned in the unit areas based on obtained information indicating an amount of ink to be ejected to each of the plurality of unit areas, where the sizes of the unit area and the area to be thinned are different from each other.

Arai is not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Specifically, Arai is not seen to disclose or suggest at least the features of dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on a recording material into a plurality of unit areas and reducing the amount of ink ejected to an area to be thinned in the unit areas based on obtained information indicating an amount of ink to be ejected to each of the plurality of unit areas, where the sizes of the unit area and the area to be thinned are different from each other.

With respect to Arai, this reference was applied in the § 103(a) rejection of Claim 8 to 10 for allegedly disclosing that the inks of the unit area and the area to be thinned are different from each other. Again, Applicants submit that this is not a claimed feature of the invention and therefore the application of this reference in this manner is believed to irrelevant to present claims.

Nagoshi, Matsubara and Lahut, which were applied in the rejections of certain other claims, are not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Specifically, Nagoshi, Matsubara and Lahut are not seen to disclose or suggest at least the features of dividing an area in the neighborhood of a

boundary between adjacent bands of scanning recording on a recording material into a plurality of unit areas and reducing the amount of ink ejected to an area to be thinned in the unit areas based on obtained information indicating an amount of ink to be ejected to each of the plurality of unit areas, where the sizes of the unit area and the area to be thinned are different from each other.

Accordingly, independent Claims 8 to 10 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 102(b) and § 103(a) rejections of Claims 8 to 10 are respectfully requested.

Independent Claims 17 and 21 concern effecting recording by ejecting ink onto a recording material on the basis of data using a recording head for ejecting the ink through a plurality of nozzles. Relative movement between the recording head and the recording material is controlled and ink is ejected from the recording head in accordance with ink ejection image data to sequentially effect recording operations for adjacent recording areas by the ink ejected from the recording head. A number of data indicative of ejection of the ink for boundary areas of adjacent recording areas is counted and the ejection data for the boundary areas is reduced based on the number of counted data, where the rate of reducing is changed according to the number of counted data.

The applied references are not seen to disclose the foregoing features of the present invention. In particular, the applied references are not seen to disclose at least the features of counting a number of data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas on the basis of the number of counted data, where the rate of reducing is changed according to the number of counted data.

Takagi describes dividing a number of ink droplets ejected for pixels in overlapped portions of an image between the two scans using a series of ratios as described in column 8, lines 1 to 9. However, Takagi is not seen to disclose that the number of ink droplets is reduced on the basis of a number of counted data indicative of ejection of ink for boundary areas, where the rate of reduction is changed according to the number of counted data. Rather, the ratios used in Takagi (2/8, 4/8, 6/8, etc.) are seen to be constant and independent of the number of ink droplets needed for particular pixels. Therefore, Takagi is not seen to disclose at least the features of counting a number of data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas on the basis of the number of counted data, where the rate of reducing is changed according to the number of counted data.

Nagoshi, Arai, Matsubara and Lahut, which were applied in the rejections of certain other claims, are not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Specifically, Nagoshi, Arai, Matsubara and Lahut are not seen to disclose or suggest at least the features of counting a number of data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas on the basis of the number of counted data, where the rate of reducing is changed according to the number of counted data.

Accordingly, independent Claims 17 and 21 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 102(b) rejection of Claims 17 and 21 are respectfully requested.

Independent Claims 4 and 24 concern ink jet recording on a recording material by ejecting ink using a recording head having a plurality of recording elements.

Recording is effected with relative scanning movement between the recording head and the recording material in a main scan direction. Relative scanning movement is imparted between the recording material and the recording head in a direction which is different from the main scan direction substantially each time after completion of a recording scan in the main scan direction. An ink ejection data number is counted for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material. A thinning rate is determined for each of the unit areas on the basis of the counted ink ejection date number and a thinning process is effected to the ink ejection data on the basis of the determined thinning rate. The unit areas exist astride the boundary between adjacent ones of the bands.

The applied references are not seen to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not seen to disclose or suggest at least the feature of determining a thinning rate for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on the recording material, where the thinning rate is determined on the basis of an ink ejection data number counted for each unit area.

The Office Action conceded that Takagi is not seen to disclose or suggest the feature of determining a thinning rate for each unit area on the basis of an ink ejection data number counted for the unit areas. To remedy this deficiency, the Office Action relied on Nagoshi in combination with Takagi. Applicants respectfully submit that Nagoshi is not seen to disclose or suggest anything to remedy this deficiency of Takagi.

Nagoshi concerns an ink-jet recording apparatus having variable scanning speeds. As described in column 4, lines 51 to 61, of Nagoshi, the apparatus can perform printing using either a single-pass mode where the recording medium is scanned once, or a multi-pass mode where a thin image is formed during each of multiple scans of the recording medium. As recognized in the Office Action, the scanning speed used in Nagoshi is adjusted according to the number of passes used to form the image on the recording medium. However, the thinning rate used to create the thin images formed during each of the multiple passes is not seen to be based on an ink ejection data number counted for unit areas. Rather, the thinning rate is seen to be predetermined based on the number of passes used to form the complete image and not affected by a counted ink ejection data number. Therefore, Nagoshi is not seen to disclose or suggest at least the feature of determining a thinning rate for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on the recording material, where the thinning rate is determined on the basis of an ink ejection data number counted for each unit area.

Arai, Matsubara and Lahut, which were applied in the rejections of certain other claims, are not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Specifically, Arai, Matsubara and Lahut are not seen to disclose or suggest at least the feature of determining a thinning rate for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording on the recording material, where the thinning rate is determined on the basis of an ink ejection data number counted for each unit area.

Accordingly, independent Claims 4 and 24 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 103(a) rejection of Claims 4 and 24 are respectfully requested.

Independent Claims 11 and 25 concern effecting recording on a recording material by ejecting ink using a recording head having a plurality of recording elements. Recording is effected with relative scanning movement between the recording head and the recording material in a main scan direction with relative scanning movement between the recording material and the recording head in a direction which is different from the main scan direction being imparted substantially each time after completion of a recording scan in the main scan direction. An ink ejection data number is counted for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material. A thinning rate for each of the unit areas is determined on the basis of the counted ink ejection data number and thinning means effects a thinning process to the ink ejection data for an area to be thinned in the unit area on the basis of the determined thinning rate. The sizes of the unit area and the area to be thinned are different from each other.

The applied references are not seen to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not seen to disclose or suggest at least the features of determining a thinning rate based on a counted ink ejection data number and effecting a thinning process to ink ejection data for an area to be thinned in a unit area where the sizes of the unit area and the area to be thinned are different from each other.

As discussed above with respect to Claim 8 to 10, the applied references are not seen to disclose or suggest the feature of an area to be thinned in a unit area and the unit area having different sizes. Furthermore, as discussed above with respect to Claims 4 and 24, the applied references are not seen to disclose or suggest the feature of determining a thinning rate on the basis of a counted ink ejection data number of a unit area. Therefore, the applied references are not seen to disclose or suggest at least the features of determining a thinning rate based on a counted ink ejection data number and effecting a thinning process to ink ejection data for an area to be thinned in a unit area where the sizes of the unit area and the area to be thinned are different from each other.

Accordingly, independent Claims 11 and 25 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 103(a) rejection of Claims 11 and 25 are respectfully requested.

The other claims in the application are dependent from the independent claims discussed above and therefore are believed to be allowable over the applied references for at least the same reasons. Because each dependent claim is deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing amendment and remarks, the entire application is now believed to be in condition for allowance and such action is respectfully requested at the Examiner's earliest convenience.

Applicants' undersigned attorney may be reached in our Costa Mesa, California, office by telephone at (714) 540-8700. All correspondence should be directed to our address given below.

Respectfully submitted,



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